CLAIMS

What is claimed is:

1. A method for transmitting signaling system seven (SS7) user part messages between SS7 signaling points comprising:

(a) receiving, at a first signal transfer point (STP), a first SS7 user part message from a first SS7 signaling point;

(b) encapsulating the first SS7 user part message in a first internet protocol (IP) packet; and

(c) transmitting the first IP packet to a second SS7 signaling point over an IP network.

2. The method of claim 1 wherein encapsulating the first SS7 user part message in a first IP packet includes adding a transmission control protocol (TCP) header to the first SS7 user part message.

3. The method of claim 1 wherein encapsulating the first SS7 user part message in a first IP packet includes adding a user datagram protocol (UDP) header to the first SS7 user part message.

4. The method of claim 1 wherein encapsulating the first SS7 user part message in a first IP packet includes adding an application-level sequence number to the first SS7 user part message.

5. The method of claim 1 wherein transmitting the first IP packet to a second SS7 signaling point includes transmitting the first IP packet without terminating user part layer communications.

6. The method of claim 1 wherein transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a local service switching point (SSP), and the IP network thereby functions as an SS7 A link between the first STP and the SSP.

7. The method of claim 1 wherein transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a second STP of the same hierarchical level as the first STP, and the IP network thereby replaces an SS7 B link between the first and second STPs.

8. The method of claim 1 wherein transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a second STP, the first and second STPs comprising a mated pair of STPs, and the IP network thereby functions as an SS7 C link between the first and second STPs.

9. The method of claim 1 wherein transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a second STP of a different hierarchical level than the first STP, and the IP network thereby functions as an SS7 D link between the first and second STPs.

10. The method of claim 1 transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a service switching point (SSP) located in a different local area from the first STP, and the IP network thereby functions as an SS7 E link between the first STP and the SSP.

11. A method for encapsulating a signaling system seven (SS7) user part message in an internet protocol (IP) packet for transmission over an IP network, the method comprising:

(a) extracting at least a portion of SS7 layer 3 and layer 4 information from an SS7 message signaling unit (MSU), the extracted portion including SS7 routing information and user part information;

(b) encapsulating the extracted portion in a transport adapter layer interface packet including an application-level sequence number; and

(c) adding an IP header including an IP address to the transport adapter layer interface packet to produce an IP packet.

12. The method of claim 11 wherein encapsulating the extracted portion in a transport adapter layer interface packet includes adding an operation code to the extracted portion, the operation code indicating the SS7 message type.

13. The method of claim 11 comprising adding a transmission control protocol (TCP) header to the transport adapter layer interface packet.

14. The method of claim 11 comprising adding a user datagram protocol (UDP) header to the transport adapter layer interface packet.

15. A method for processing an internet protocol (IP) encapsulated signaling system seven (SS7) user part message utilizing a signal transfer point (STP), the method comprising:

(a) receiving, at a first STP, an IP-encapsulated SS7 user part message transmitted from a first SS7 signaling point over an IP network;

(b) removing an IP header from the message;

(c) reading at least message transfer part (MTP) layer 3 information from the message; and

(d) routing the message based on at least the MTP layer 3 information.

16. The method of claim 15 comprising removing a transmission control protocol (TCP) header from the message.

17. The method of claim 15 comprising removing a user datagram protocol (UDP) header from the message.

18. The method of claim 15 wherein reading at least MTP layer 3 information includes reading the MTP layer 3 information and Signaling Connection and Control Part (SCCP) layer information and wherein routing the message includes routing the message based on the MTP layer 3 information and the SCCP layer information.

19. The method of claim 15 comprising removing a transport adapter layer interface header from the message.

20. The method of claim 15 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point over an IP

network comprises receiving an IP-encapsulated user part message from a local service switching point (SSP), and the IP network thereby functions as an SS7 A link.

21. The method of claim 15 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point over an IP network comprises receiving an IP-encapsulated user part message from a second STP of the same hierarchical level as the first STP, and the IP network thereby functions as an SS7 B link between the first and second STPs.

22. The method of claim 15 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point over an IP network comprises receiving an IP-encapsulated user part message from a second STP, the first and second STPs comprising a mated pair of STPs, and the IP network thereby functions as an SS7 C link between the first and second STPs.

23. The method of claim 15 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point over an IP network comprises receiving an IP-encapsulated user part message from a second STP of a different hierarchical level than the first STP, and the IP network thereby functions as an SS7 D link between the first and second STPs.

24. The method of claim 15 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point comprises receiving an IP-encapsulated user part message from a service switching point (SSP) located in a different local area from the first STP, and the IP network thereby functions as an SS7 E link between the first STP and the SSP.

25. A method for reliably recovering signaling system seven (SS7) user part message packets in response to a socket failure, the method comprising:

(a) transmitting IP-encapsulated SS7 messages from a first node to a second node over the first and second sockets, the messages each including an application-level sequence number for sequencing messages received by the first and second nodes; and

(b) in response to failure of the first socket, transmitting, over the second socket, a first recovery packet from the first node to the second node, the first recovery packet including an application-level sequence number indicating the last message received by the first node.

26. The method of claim 25 wherein transmitting messages over first and second sockets includes transmitting messages over first and second transmission control protocol (TCP) sockets.

27. The method of claim 25 wherein transmitting messages over first and second sockets includes transmitting messages over first and second user datagram protocol (UDP) sockets.

28. The method of claim 25 comprising, after receiving the first recovery packet at the second node, resuming data communications with the first node over the second socket based on the application-level sequence number.

29. The method of claim 25 wherein the first and second nodes comprise SS7 nodes.

30. The method of claim 25 wherein the first and second nodes comprise IP nodes.

31. The method of claim 25 wherein the first node is an SS7 node and the second node is an IP node.

32. A data structure embodied in a computer readable medium for communicating signaling system seven (SS7) user part messages between SS7 nodes, the data structure comprising:

(a) a service field for storing message transfer part (MTP) layer 3 information and user part information;

(b) an application-level sequence number field for storing an application-level sequence number; and

(c) an internet protocol (IP) header field for storing IP information including an IP address.

33. The data structure of claim 32 comprising a transmission control protocol (TCP) header field for storing TCP header information.

34. The data structure of claim 32 comprising an opcode field for storing information indicating SS7 message type.

35. A signal transfer point (STP) comprising:

(a) means for receiving an incoming signaling system seven (SS7) message transmitted from a first SS7 node and for determining whether the message is destined for an external node; and

(b) a signaling system seven/internet protocol (SS7/IP) user part message communicator for, in response to a determination that the message is destined for an external node, for adding an internet protocol (IP) header to the message and transmitting the message to a second SS7 node over an IP network.

36. The signal transfer point of claim 35 wherein the SS7/IP user part message communicator comprises an application layer and an SS7/IP converter, the application layer being adapted to determine components of the SS7 message to be passed to the SS7/IP converter, the SS7/IP converter being adapted to add the IP header to components of the message received from the application layer.

37. The signal transfer point of claim 36 wherein the application layer is adapted to pass at least some of message transfer part (MTP) layer three information to the SS7/IP converter.

38. The signal transfer point of claim 36 wherein the SS7/IP converter is adapted to add an application-level sequence number to the components of the message received from the application layer.

39. The signal transfer point of claim 35 wherein the means for receiving comprises a message discrimination function for determining whether the message is destined for an external signaling point, and a routing function for routing the message to the SS7/IP user part message communicator in response to a determination that the message is destined for an external node.

40. The signal transfer point of claim 35 wherein the SS7/IP user part message communicator is adapted to add a transmission control protocol (TCP) header to the message.

41. The signal transfer point of claim 35 wherein the SS7/IP user part message communicator is adapted to add a user datagram protocol (UDP) header transport layer to the message.

42. The signal transfer point of claim 35 wherein the SS7/IP user part message communicator is adapted to receive an incoming IP-encapsulated user part message and remove IP layer information from the IP-encapsulated user part message.

43. The signal transfer point of claim 35 wherein the SS7/IP user part message communicator is adapted to transmit the message to a local SSP over an IP network, and the IP network thereby functions as an SS7 A link.

44. The signal transfer point of claim 35 wherein the SS7/IP user part message communicator is adapted to transmit the message to an STP over an IP network, and the IP network thereby functions as an SS7 B link.

45. The signal transfer point of claim 35 wherein the SS7/IP user part message communicator is adapted to transmit the message to an STP over an IP network, and the IP network thereby functions as an SS7 C link.

46. The signal transfer point of claim 35 wherein the SS7/IP user part message communicator is adapted to transmit the message to an STP over an IP network, and the IP network thereby functions as an SS7 D link.

47. The signal transfer point of claim 35 wherein the SS7/IP user part message communicator is adapted to transmit the message to a remote SSP over an IP network, and the IP network thereby functions as an SS7 E link.

48. A signaling system seven/internet protocol (SS7/IP) user part message communicator comprising computer-executable instructions embodied in a computer-readable medium for performing steps comprising:

(a) receiving, at a first signal transfer point (STP), a first SS7 user part message from a first SS7 signaling point;

(b) encapsulating the first SS7 user part message in a first IP packet; and

(c) transmitting the first IP packet to a second SS7 signaling point over an IP network.

49. The SS7/IP user part message communicator of claim 48 wherein encapsulating the first SS7 user part message in a first IP packet includes adding a transmission control protocol (TCP) header to the first SS7 user part message.

50. The SS7/IP user part message communicator of claim 48 wherein encapsulating the first SS7 user part message in a first IP packet includes adding a user datagram protocol (UDP) header to the first SS7 user part message.

51. The SS7/IP user part message communicator of claim 48 wherein encapsulating the first SS7 user part message in a first IP packet includes adding an application-level sequence number to the first SS7 user part message.

52. The SS7/IP user part message communicator of claim 48 wherein transmitting the first IP packet to a second SS7 signaling point includes transmitting the first IP packet without terminating user part layer communications.

53. The SS7/IP user part message communicator of claim 48 wherein transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a service switching point (SSP), and the IP network thereby functions as an SS7 A link between the first STP and the SSP.

54. The SS7/IP user part message communicator of claim 48 wherein transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a second STP of the same hierarchical level as the first STP, and the IP network thereby replaces an SS7 B link between the first and second STPs.

55. The SS7/IP user part message communicator of claim 48 wherein transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a second STP, the first and second STPs comprising a mated pair of STPs, and the IP network thereby functions as an SS7 C link between the first and second STPs.

56. The SS7/IP user part message communicator of claim 48 wherein transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a second STP of a different hierarchical level than the first STP, and the IP network thereby functions as an SS7 D link between the first and second STPs.

57. The SS7/IP user part message communicator of claim 48 wherein transmitting the first IP packet to a second SS7 signaling point over an IP network comprises transmitting the IP packet to a service switching point (SSP) located in a different local area from the first STP, and the IP network thereby functions as an SS7 E link between the first STP and SSP.

58. A signaling system seven/internet protocol (SS7/IP) user part message communicator comprising computer-executable instructions embodied in a computer-readable medium for performing steps comprising:

(a) extracting at least a portion of SS7 layer 3 and layer 4 information from an SS7 message signaling unit (MSU), the extracted portion including SS7 routing information for the MSU and user part information for the MSU;

(b) encapsulating the extracted portion in a transport adapter layer interface packet including an application-level sequence number; and

(c) adding an IP header including an IP address to the transport adapter layer interface packet to produce an IP packet.

59. The SS7/IP user part message communicator of claim 58 wherein encapsulating the extracted portion in a transport adapter layer interface packet includes adding an operation code to the extracted portion, the operation code indicating the SS7 message type.

60. The SS7/IP user part message communicator of claim 58 comprising adding a transmission control protocol (TCP) header to the transport adapter layer interface packet.

61. The SS7/IP user part message communicator of claim 58 comprising adding a user datagram protocol (UDP) header to the transport adapter layer interface packet.

62. A computer program product comprising computer-executable instructions embodied in a computer-readable medium for performing steps comprising:

(a) receiving, at a first signal transfer point (STP), an internet protocol (IP) encapsulated signaling system seven (SS7) user part message transmitted from a first SS7 signaling point over an IP network;

(b) removing an IP header from the message;

(c) reading at least message transfer part (MTP) layer 3 information from the message; and

(d) routing the message based on at least the MTP layer 3 information.

63. The computer program product of claim 62 comprising removing a transmission control protocol (TCP) header from the message.

64. The computer program product of claim 62 comprising removing a user datagram protocol (UDP) header from the message.

65. The computer program product of claim 62 wherein reading at least MTP layer 3 information includes reading the MTP layer 3 information and Signaling Connection and Control Part (SCCP) layer information and wherein routing the message includes routing the message based on the MTP layer 3 information and the SCCP layer information.

66. The computer program product of claim 62 comprising removing a transport adapter layer interface header from the message.

67. The computer program product of claim 62 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point over an IP network comprises receiving an IP-encapsulated user part message from a local service switching point (SSP), and the IP network thereby functions as an SS7 A link.

68. The computer program product of claim 62 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point over an IP network comprises receiving an IP-encapsulated user part message from a second STP of the same hierarchical level as the first STP, and the IP network thereby functions as an SS7 B link between the first and second STPs.

69. The computer program product of claim 62 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point over an IP network comprises receiving an IP-encapsulated user part message from a second STP, the first and second STPs comprising a mated pair of STPs, and the IP network thereby functions as an SS7 C link between the first and second STPs.

70. The computer program product of claim 62 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point over an IP network comprises receiving an IP-encapsulated user part message from a second STP of a different hierarchical level than the first STP, and the IP network thereby functions as an SS7 D link between the first and second STPs.

71. The computer program product of claim 62 wherein receiving an IP-encapsulated user part message transmitted from a first SS7 signaling point comprises receiving an IP-encapsulated user part message from a service switching point (SSP) located in a different local area from the first STP, and the IP network thereby functions as an SS7 E link between the first STP and the SSP.

72. A signaling system seven (SS7) message recovery routine comprising a computer-product including computer-executable instructions embodied in a computer-readable medium for performing steps comprising:

(a) transmitting internet protocol (IP) encapsulated SS7 messages from a first node to a second node over the first and second sockets, the messages each including an application-level sequence number for sequencing messages received by the first and second nodes; and

(b) in response to failure of the first socket, transmitting, over the second socket, a first recovery packet from the first node to the second node, the first recovery packet including an application-level sequence number indicating the last message received by the first node.

73. The SS7 message recovery routine method of claim 72 wherein transmitting data packets over first and second sockets includes transmitting data packets over first and second transmission control protocol (TCP) sockets.

74. The SS7 message recovery routine of claim 72 wherein transmitting messages over first and second sockets includes transmitting messages over first and second user datagram protocol (UDP) sockets.

75. The SS7 message recovery routine of claim 72 comprising, after receiving the first recovery packet at the second node, resuming data communications with the first node over the second socket based on the application-level sequence number.

76. The SS7 message recovery routine of claim 72 wherein transmitting messages from a first node to a second node comprises transmitting messages from a first SS7 node to a second SS7 node.

77. The SS7 message recovery routine of claim 72 wherein transmitting messages from a first node to a second node comprises transmitting messages from a first SS7 node to a first IP node.

78. The SS7 message recovery routine of claim 72 wherein transmitting messages from a first node to a second node comprises transmitting messages from a first IP node to a second IP node.

ADD A5

add B'